

# Total Ecosystem Approach to Terrestrial Carbon Sequestration



Coal Industry Perspective

November 6, 2001

# SURFACE MINING

- Surface mining is the preferred mining method
  - Cheaper
  - Employees are above ground
  - More coal is recovered
  - Less preparation (washing) required
- Prior to 1977 overburden (soil) was left loose (uncompacted)
  - Many disturbed areas have supported growth of new forest with growth rates greater than adjacent undisturbed lands

# **SURFACE MINE ACT OF 1977**

- Act Required Mine Operators to take steps to reclaim mined lands.
  - Post Reclamation Bond
  - Return Land to Approximate Original Contour
    - Mining Companies routinely made the surface smooth by making multiple passes over the surface compacting soils

# RECLAIMED MINE LAND POTENTIAL AS A SITE FOR CARBON SEQUESTRATION

- Growth potential given proper conditions



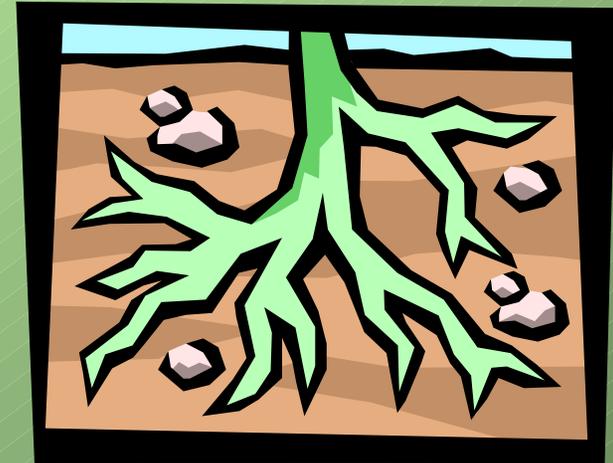
# STEPS FOR SUCCESSFUL CARBON SEQUESTRATION ON MINE SITES

- Site Preparation
- Tree Species Selection
- Planting



# SITE PREPARATION

- The Root of the Problem
  - Excessive Compaction of Reclaimed Soils
    - Post Law Requirements
    - Return the approximate original contour
    - Operators achieve original contour by making multiple passes over surface to be reclaimed

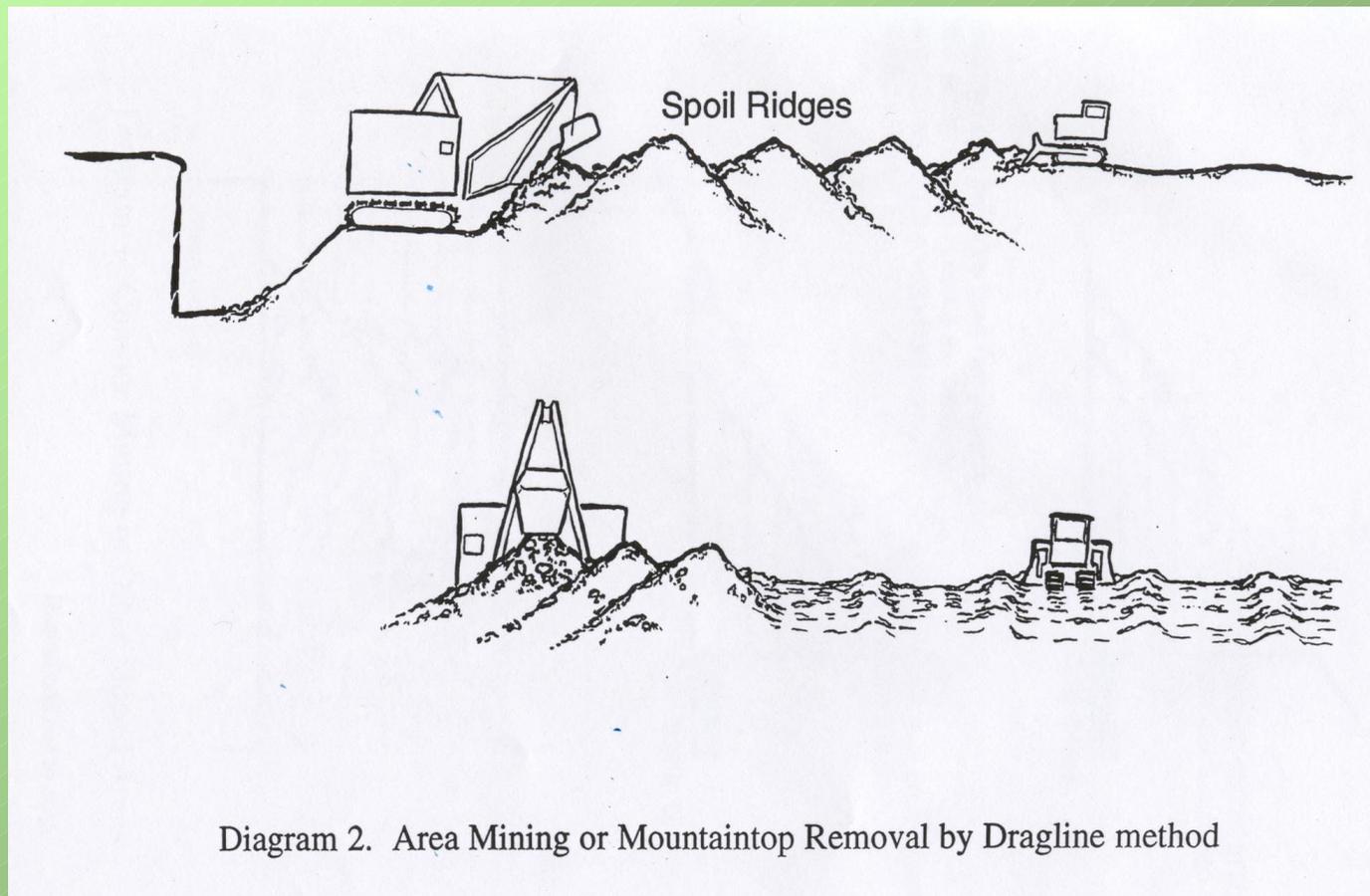


# TYPICAL POST LAW RECLAMATION PRACTICES



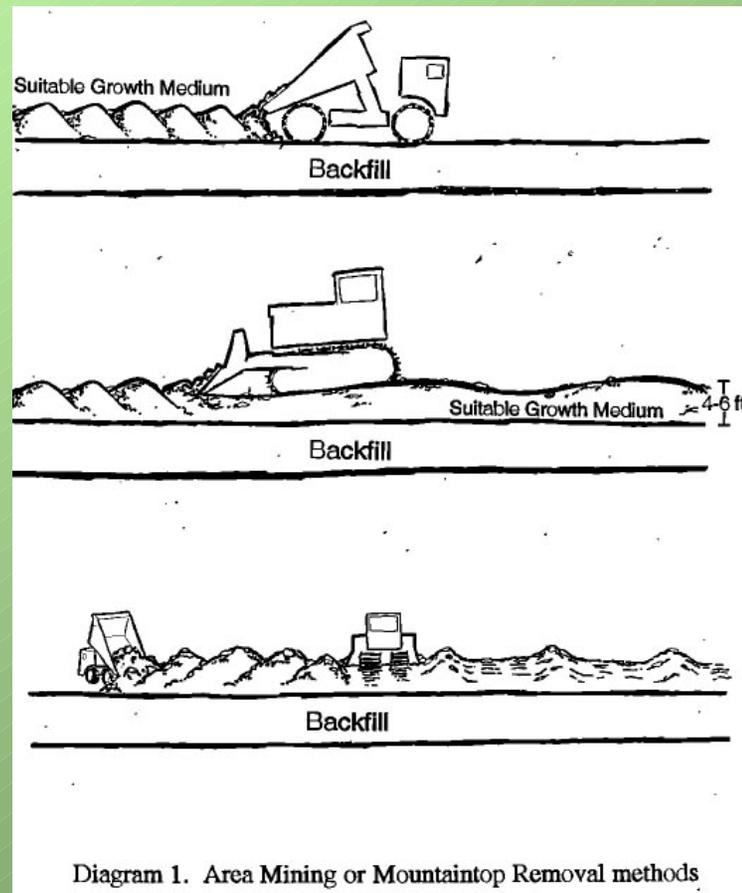
# PREFERRED SITE PREPARATION

- Mountain Top Removal with Dragline



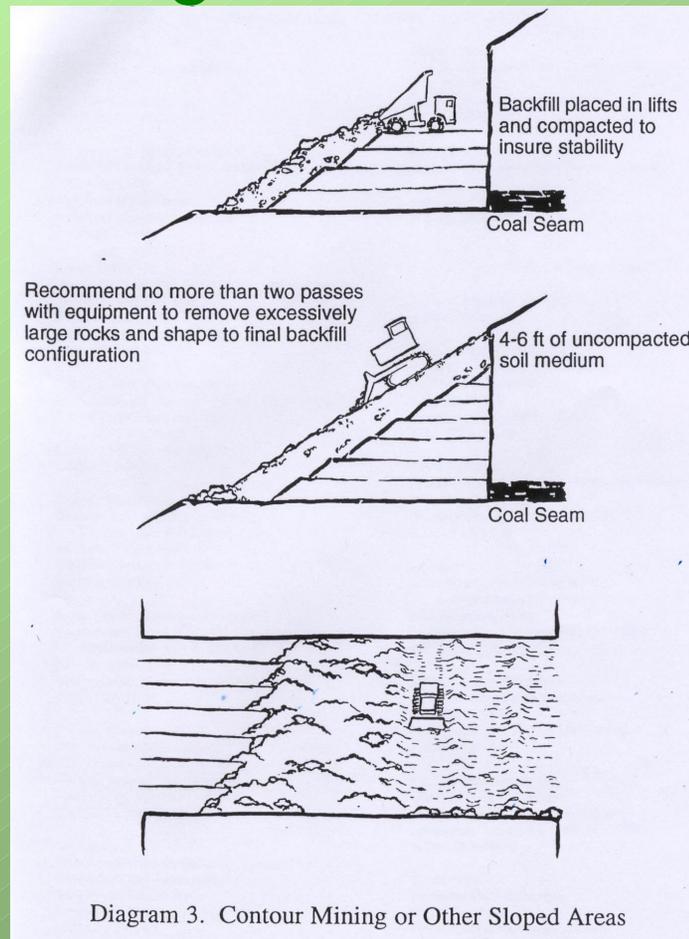
# PREFERRED SITE PREPARATION

- Mountain Top Removal Area Reclaim



# PREFERRED SITE PREPARATION

- Contour Mining Area Reclaim



# ACTUAL SITE PREPARATION

- Examples of Preferred Reclamation Methods



# PREPARATION OF POST LAW LANDS

- In areas where reclaimed lands were excessively compacted it is necessary to rework the land to facilitate tree growth



# TREE SPECIES SELECTION

- Tree species selection is key to the success of carbon sequestration efforts on reclaimed mine lands

## Starfire High Value Tree Reclamation Project

Average Survival, Height, and Growth

Cells 1 - 15  
1997-2001

	Species	% Survival					Height (cm)					Growth (cm)			
		1997	1998	1999	2000	2001	1997	1998	1999	2000	2001	1998	1999	2000	2001
Uncompact	white pine	92	81	82	81	82	36	42	66	112	153	6	24	46	41
	white ash	95	88	86	69	87	40	51	71	100	131	11	19	29	31
	black walnut	97	68	76	65	75	77	75	66	83	90	-2	-9	17	7
	yellow-poplar	93	86	77	64	83	24	32	48	81	107	8	16	33	26
	royal paulownia	37	29	40	33	30	9	66	104	276	275	57	39	171	-1
	white oak	88	69	87	70	83	28	32	39	60	88	4	7	21	28
	northern red oak	99	86	85	73	84	28	31	41	67	100	4	10	26	33
		<b>86</b>	<b>72</b>	<b>76</b>	<b>65</b>	<b>75</b>	<b>37</b>	<b>45</b>	<b>59</b>	<b>111</b>	<b>135</b>	<b>7</b>	<b>14</b>	<b>49</b>	<b>24</b>
Rough Grade	white pine	87	52	51	50	50	34	36	46	70	97	2	11	24	27
	white ash	98	86	85	86	78	41	54	71	90	106	13	17	12	16
	black walnut	100	61	61	52	59	82	72	63	77	75	-11	-9	14	-2
	yellow-poplar	94	63	61	51	59	24	29	40	61	74	5	10	21	13
	royal paulownia	52	32	44	35	30	11	63	92	156	198	52	29	64	42
	white oak	94	55	78	66	68	29	31	33	49	72	2	2	16	23
	northern red oak	96	71	70	57	62	29	28	31	58	85	-1	3	27	27
		<b>89</b>	<b>60</b>	<b>64</b>	<b>57</b>	<b>58</b>	<b>38</b>	<b>44</b>	<b>52</b>	<b>80</b>	<b>101</b>	<b>6</b>	<b>8</b>	<b>25</b>	<b>21</b>
Compact	white pine	37	18	12	8	5	34	33	32	23	23	-1	-1	-9	0
	white ash	91	87	85	62	82	40	43	45	52	66	3	2	7	14
	black walnut	41	26	34	13	15	79	51	31	30	30	-28	-20	-1	0
	yellow-poplar	59	50	30	9	15	27	25	21	44	40	-3	-4	23	-4
	royal paulownia	21	7	12	8	8	23	76	82	86	126	53	6	4	40
	white oak	49	25	49	25	27	27	24	16	25	33	-3	-7	9	8
	northern red oak	82	66	51	19	23	27	20	17	38	33	-7	-3	21	-5
		<b>54</b>	<b>40</b>	<b>39</b>	<b>21</b>	<b>25</b>	<b>36</b>	<b>34</b>	<b>31</b>	<b>42</b>	<b>50</b>	<b>-3</b>	<b>-2</b>	<b>8</b>	<b>8</b>
Dozer Ripped	white pine	---	---	---	46	44	---	---	---	35	48	---	---	---	13
	white ash	---	---	---	76	88	---	---	---	53	65	---	---	---	12
	black walnut	---	---	---	58	62	---	---	---	53	50	---	---	---	-3
	yellow-poplar	---	---	---	31	32	---	---	---	40	50	---	---	---	10
	royal paulownia	---	---	---	25	22	---	---	---	39	87	---	---	---	48
	white oak	---	---	---	49	43	---	---	---	33	38	---	---	---	5
	northern red oak	---	---	---	54	50	---	---	---	35	37	---	---	---	2
				<b>48</b>	<b>49</b>				<b>41</b>	<b>54</b>				<b>72</b>	
Tractor Ripped	white pine	---	---	---	26	25	---	---	---	36	49	---	---	---	13
	white ash	---	---	---	69	84	---	---	---	49	62	---	---	---	13
	black walnut	---	---	---	53	48	---	---	---	53	53	---	---	---	0
	yellow-poplar	---	---	---	33	33	---	---	---	45	48	---	---	---	3
	royal paulownia	---	---	---	0	0	---	---	---	0	0	---	---	---	0
	white oak	---	---	---	45	42	---	---	---	28	35	---	---	---	7
	northern red oak	---	---	---	41	36	---	---	---	33	39	---	---	---	6
				<b>38</b>	<b>38</b>				<b>35</b>	<b>41</b>				<b>6</b>	

# SPECIES ALTERNATIVES

- The Paulownia tree has demonstrated excellent results on reclaimed lands



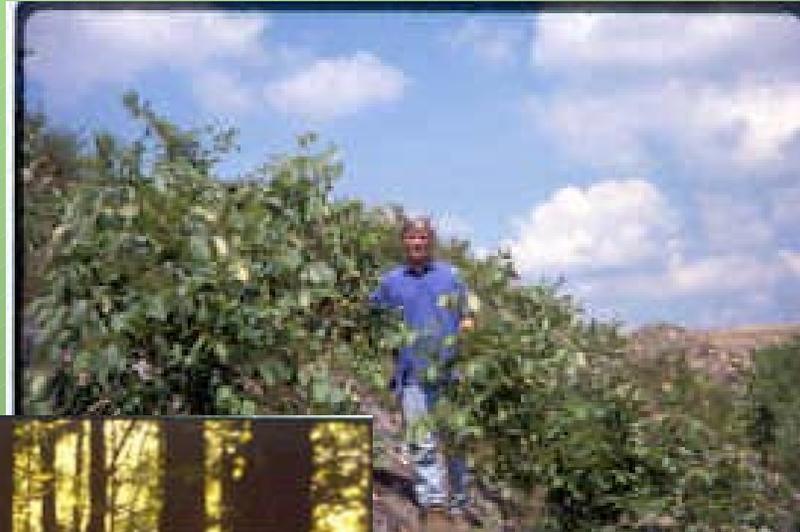
# PLANTING

- Typically planting is a manual operation



# FINAL RESULTS

- Examples of successful tree planting on reclaimed mine lands



# ADDITIONAL BENEFITS

- Improved wildlife habitat



# ADDITIONAL BENEFITS

- Improved Water Quality



# ADDITIONAL BENEFITS

- Renewable Timber Resource



# CONCLUSION

- There are several million acres of surface mined land in Appalachia.
- A large portion of this land has been compacted to the point where it will not support trees.
- Recovering and reforesting surface mined lands is a practical and efficient means to sequester carbon for extended times.

# RECOMMENDATIONS

- If there is a CO<sub>2</sub> problem then it is everyone's problem
  - There should be a Federal program to reforest all the surface mined lands of Appalachia.
  - The program should reach beyond mined lands to include fallow and marginal farm lands.
  - A tax credit or carbon credit plan should be developed to encourage this practice.